

Docket No. 202462152



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Tomohiro NAKAJIMA et al.

SERIAL NO: 09/769,510

GAU: 2876

FILED: January 26, 2001

EXAMINER: PAIK, S. S.

FOR: OPTICAL SCAN MODULE, OPTICAL SCANNER, OPTICAL SCAN METHOD, IMAGE GENERATOR AND IMAGE READER

**INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR 1.97**

COMMISSIONER FOR PATENTS  
ALEXANDRIA, VIRGINIA 22313

SIR:

Applicant(s) wish to disclose the following information.

**REFERENCES**

- The applicant(s) wish to make of record the references listed on the attached form PTO-1449. Copies of the listed references are attached, where required, as are either statements of relevancy or any readily available English translations of pertinent portions of any non-English language references.
- A check is attached in the amount required under 37 CFR §1.17(p).

**RELATED CASES**

- Attached is a list of applicant's pending application(s) which may be related to the present application. A copy of the claims and drawings of the pending application(s) is attached.
- A check is attached in the amount required under 37 CFR §1.17(p).

**CERTIFICATION**

- Each item of information contained in this information disclosure statement was first cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement.
- No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application or, to the knowledge of the undersigned, having made reasonable inquiry, was known to any individual designated in 37 CFR §1.56(c) more than three months prior to the filing of this statement.

**DEPOSIT ACCOUNT**

- Please charge any additional fees for the papers being filed herewith and for which no check is enclosed herewith, or credit any overpayment to deposit account number 15-0030. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

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### LIST OF RELATED CASES

<u>Docket Number</u>	<u>Serial or Patent Number</u>	<u>Filing or Issue Date</u>	<u>Inventor/Applicant</u>
202462US2*	09/769,510	01/26/01	NAKAJIMA et al.
235228US2	10/386,654	03/13/03	AMADA et al.

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\*Present Application; listed for information  
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WHAT IS CLAIMED IS:

5

1. An optical scanning apparatus for scanning a surface to be scanned in a main scanning direction by simultaneously using a plurality of optical spots formed of a plurality of optical beams emitted from an 10 illuminant, comprising:

a light path deflecting part deflecting a light path of at least one of said optical beams,

wherein said light path deflecting part is provided in light paths of said optical beams.

15

2. The optical scanning apparatus as claimed 20 in claim 1, wherein said light path deflecting part uses a liquid crystal deflecting element formed of a liquid crystal element being controllable by an electronic signal to deflect the light path of said one of the optical beams.

25

FOR INFORMATION  
DISCLOSURE  
PURPOSES ONLY

Related Pending Application  
Related Case Serial No: 10/386,654  
Related Case Filing Date: 03-13-03

3. The optical scanning apparatus as claimed  
5 in claim 2, wherein said liquid crystal deflecting  
element is capable of deflecting optical beams  
separately in two directions orthogonal to each other.

10

4. The optical scanning apparatus as claimed  
in claim 2, wherein said liquid crystal deflecting  
element has a plurality of effective areas each of which  
15 is separately modulated.

20

5. The optical scanning apparatus as claimed  
in claim 2, wherein said illuminant comprises at least a  
semiconductor laser serving as an illuminant point and a  
coupling lens coupling laser light emitted from said  
semiconductor laser.

25

6. The optical scanning apparatus as claimed  
5 in claim 2, further comprising a beam synthesizing part  
synthesizing optical beams emitted from a plurality of  
illuminants.

10

7. The optical scanning apparatus as claimed  
in claim 6, wherein each of said illuminants comprises  
at least a semiconductor laser serving as an illuminant  
15 point and a coupling lens coupling laser light emitted  
from said semiconductor laser, and said semiconductor  
and said coupling lens are arranged so as to correct a  
synthesis error by said beam synthesizing part.

20

8. The optical scanning apparatus as claimed  
in claim 2, further comprising an aperture member having  
25 an aperture for shaping an optical beam wherein said

aperture member is provided in an upper stream side, that is, in an illuminant side, of the liquid crystal deflecting element in the light paths of the optical beams.

5

9. The optical scanning apparatus as claimed  
10 in claim 8, wherein said aperture for shaping an optical beam is formed on one of an entrance surface and an exit surface of said liquid crystal deflecting element.

15

10. The optical scanning apparatus as claimed in claim 2, further comprising a detecting part detecting positions of said optical spots for 20 simultaneously scanning said surface to be scanned and a driving part driving/controlling a liquid crystal deflecting element based on a detection result of said detecting part so as to adjust a position of at least one of said optical spots.

25

11. An illuminant apparatus for emitting a  
5 plurality of optical beams and serving an optical  
scanning apparatus for scanning a surface to be scanned  
in a main scanning direction by simultaneously using a  
plurality of optical spots formed of said optical beams  
emitted from a plurality of illuminants therein, wherein  
10 said optical scanning apparatus comprises a light path  
deflecting part, which is provided in light paths of  
said optical beams, deflecting a light path of at least  
one of said optical beams, comprising:

a plurality of light path deflecting parts  
15 separately deflecting one of said optical beams  
corresponding to each of said light path deflecting  
parts,

wherein said light path deflecting parts are  
integrally provided.

20

12. The illuminant apparatus as claimed in  
25 claim 11, wherein said light path deflecting part is

formed of a transmission type optical element and is provided in light paths of the optical beams.

5

13. The illuminant apparatus as claimed in  
claim 11, wherein said light path deflecting part is  
formed of a reflection type optical element and is  
10 provided in light paths of the optical beams.

15

14. The illuminant apparatus as claimed in  
claim 12, wherein said transmission type optical element  
is driven by a driving part using a piezoelectric  
element.

20

15. The illuminant apparatus as claimed in  
claim 13, wherein said reflection type optical element  
25 is driven by a driving part using a piezoelectric

element.

5

16. The illuminant apparatus as claimed in  
claim 12, wherein said transmission type optical element  
is driven by a driving part using one of a pulse motor  
capable of rotating by a predetermined angle in  
10 accordance with an input pulse signal and a pulse motor  
capable of moving straight by a predetermined distance  
in accordance with an input pulse signal.

15

17. The illuminant apparatus as claimed in  
claim 13, wherein said reflection type optical element  
is driven by a driving part using one of a pulse motor  
20 capable of rotating by a predetermined angle in  
accordance with an input pulse signal and a pulse motor  
capable of moving straight by a predetermined distance  
in accordance with an input pulse signal.

25

18. The illuminant apparatus as claimed in  
claim 11, wherein said light path deflecting part is  
5 formed of a liquid crystal element driven by an  
electronic signal.

10

19. The illuminant apparatus as claimed in  
claim 11, further comprising a first illuminant part  
integgrally having a plurality of illuminants aligned in  
line in the main scanning direction, a second illuminant  
15 part integrally having a plurality of illuminants  
aligned in line in the main scanning direction, and a  
beam synthesizing part making optical beams emitted from  
said first illuminant part and said second illuminant  
part close to each other and emitting said close optical  
20 beams.

25

20. The illuminant apparatus as claimed in

claim 11, wherein said illuminants comprises a plurality of semiconductor lasers and a plurality of coupling lenses corresponding to said semiconductor lasers.

5

21. The illuminant apparatus as claimed in claim 11, further comprising an aperture member having 10 an aperture for shaping an optical beam, wherein said aperture member is provided in an upper stream side, that is, an illuminant side, of said light path deflecting parts.

15

22. An optical scanning apparatus for scanning a surface to be scanned in a main scanning 20 direction by simultaneously using a plurality of optical spots formed of a plurality of optical beams emitted from a plurality of illuminants in an illuminant apparatus wherein said illuminant apparatus comprises a plurality of light path deflecting parts, which is 25 integrally provided therein, deflecting one of said

optical beams corresponding to each of said light path deflecting parts, comprising:

5 a detecting part detecting positions of said optical spots for simultaneously scanning said surface to be scanned; and

a driving part driving/controlling said light path deflecting parts based on a detection result of said detecting part so as to adjust a position of at least one of said optical spots.

10

23. The optical scanning apparatus as claimed  
15 in claim 22, further comprising a deflector deflecting said optical beams emitted from said illuminants and a scanning type imaging system scanning said surface to be scanned by using said optical spots formed of said optical beams deflected, wherein said optical beams from  
20 said illuminants enter said deflector non-parallel with each other with respect to the main scanning section.

25

24. The optical scanning apparatus as claimed in claim 1, further comprising an illuminant apparatus formed of a plurality of illuminants, a beam synthesizing part synthesizing a plurality of optical 5 beams emitted from said illuminant apparatus, a deflector deflecting said optical beams synthesized by said beam synthesizing part, and a scanning part leading said optical beams deflected by said deflector on said surface to be scanned, wherein said light path 10 deflecting part is provided between said illuminants and said beam synthesizing part so as to adjust positions of said optical beams on said surface to be scanned.

15

25. The optical scanning apparatus as claimed in claim 24, wherein said light path deflecting part is formed of a transmission type optical element that is 20 eccentrically provided.

25

26. The optical scanning apparatus as claimed

in claim 24, wherein said light path deflecting part is formed of a liquid crystal element controllable by an electronic signal.

5

27. The optical scanning apparatus as claimed in claim 26, further comprising a ghost light removing part removing ghost light caused by said liquid crystal element, wherein said ghost light removing part is provided as a slit aperture between said liquid crystal element and said deflector.

15

28. The optical scanning apparatus as claimed in claim 27, further comprising an aperture shaping an optical beam, wherein said aperture is provided in an upper stream side, that is, an illuminant side, of said light path deflecting part and the following formula is satisfied;

$$L \geq (b + \Delta) / (2 \times \tan \theta),$$

25 where  $b$  is a width of optical beams deflected by said

liquid crystal element,  $\Delta$  is a width of said slit aperture, L is a distance between said liquid crystal element and said slit aperture, and  $2\theta$  is an angle between +1st-order light and -1st-order light of said 5 ghost light caused by said liquid crystal element.

10                   29. The optical scanning apparatus as claimed in claim 24, further comprising an optical housing accommodating parts thereof, wherein said optical housing holds said illuminant apparatus on a side wall thereof and holds said light path deflecting part and 15 said beam synthesizing part on a common holding part therein.

20

30. An image forming apparatus for forming an image, comprising:

an optical scanning apparatus for scanning a surface to be scanned in a main scanning direction by 25 simultaneously using a plurality of optical spots formed

of a plurality of optical beams emitted from an illuminant comprising a light path deflecting part deflecting a light path of at least one of said optical beams, wherein said light path deflecting part is 5 provided in light paths of said optical beams;

                  a photoreceptor forming an electrostatic latent image scanned by said optical scanning apparatus;

                  a developing apparatus developing said electrostatic latent image as a toner image with a 10 toner; and

                  a transferring apparatus transferring said toner image in a recording medium.

15

31. An image forming apparatus for forming an image, comprising:

                  an optical scanning apparatus for scanning a 20 surface to be scanned in a main scanning direction by simultaneously using a plurality of optical spots formed of a plurality of optical beams emitted from a plurality of illuminants in an illuminant apparatus wherein said illuminant apparatus comprises a plurality of light path 25 deflecting parts, which is integrally provided therein,

deflecting one of said optical beams corresponding to  
each of said light path deflecting parts, comprising a  
detecting part detecting positions for simultaneously  
scanning said surface to be scanned and a driving part  
5 driving/controlling said light path deflecting parts  
based on a detection result of said detecting part so as  
to adjust a position of at least one of said optical  
spots;

10 a photoreceptor forming an electrostatic  
latent image scanned by said optical scanning apparatus;  
a developing apparatus developing said  
electrostatic latent image as a toner image with a  
toner; and  
15 a transferring apparatus transferring said  
toner image in a recording medium.

20 32. The image forming apparatus as claimed in  
claim 30, wherein said light path deflecting part is  
driven/controlled by an operator based on an output  
image on said recording medium.

33. The image forming apparatus as claimed in  
claim 30, further comprising a plurality of said  
5 photoreceptors serving as a plurality of surfaces to be  
scanned.

10

34. The image forming apparatus as claimed in  
claim 30, further comprising a plurality of said optical  
scanning apparatuses wherein said optical scanning  
apparatuses are aligned in line in the main scanning  
15 direction for said photoreceptor.

20 35. The image forming apparatus as claimed in  
claim 30, wherein said image has variable pixel density.

25

36. An optical scanning apparatus for scanning a surface to be scanned by using a beam spot formed of an optical beam emitted from a semiconductor laser, comprising:

5                   a liquid crystal element deflecting a light path of said optical beam on said surface to be scanned; and

                  a light rotating part rotating a polarization plane of said optical beam.

10

37. The optical scanning apparatus as claimed  
15 in claim 36, wherein said light rotating part is formed of a 1/2 wavelength plate.

20

38. The optical scanning apparatus as claimed in claim 37, wherein said 1/2 wavelength plate is held by a rotation adjusting part and is capable of rotating upon an optical axis.

25

39. The optical scanning apparatus as claimed  
5 in claim 36, wherein a position of said optical spot is  
adjusted on the surface to be scanned by deflecting a  
light path of said optical beam in a subscanning section  
of said liquid crystal element.

10

40. The optical scanning apparatus as claimed  
in claim 36, wherein said semiconductor laser is formed  
15 of a semiconductor laser array having a plurality of  
illuminant points.

20

41. The optical scanning apparatus as claimed  
in claim 40, wherein said semiconductor laser array is  
inclined toward an optical axis of said optical beam  
emitted.

25

42. The optical scanning apparatus as claimed  
5 in claim 39, wherein said surface to be scanned is  
scanned by an optical beam synthesized from at least two  
optical beams emitted from at least two semiconductor  
lasers by using a PBS (Polarization Beam Splitter)  
surface, and said liquid crystal element is arranged so  
10 as to convert an optical beam emitted from said liquid  
crystal element into one of an S-polarized optical beam  
or a P-polarized optical beam toward said PBS surface.

15

43. The optical scanning apparatus as claimed  
in claim 39, wherein said surface to be scanned is  
scanned by an optical beam synthesized from at least two  
20 optical beams emitted from at least two semiconductor  
lasers by using a half-mirror.

25

44. An image forming apparatus for forming an image, comprising:

an optical scanning apparatus for scanning a surface to be scanned by using an optical spot formed of  
5 an optical beam emitted from a semiconductor laser, the optical scanning apparatus comprising a liquid crystal element deflecting a light path of said optical beam on said surface to be scanned and a light rotating part rotating a polarization plane of said optical beam;  
10 a photoreceptor forming an electrostatic latent image scanned by said optical scanning apparatus; a developing part developing said electrostatic latent image as a toner image with a toner; and  
15 a transferring part transferring said toner image in a recording medium.

20

45. The image forming apparatus as claimed in claim 44, wherein said optical scanning apparatus scans said photoreceptor by using a plurality of beam spots formed of a plurality of optical beams and is capable of  
25 adjusting a scanning line pitch on said photoreceptor.

5               46. The image forming apparatus as claimed in  
claim 44, wherein said optical scanning apparatus scans  
said photoreceptor by using a plurality of optical beams  
and is capable of switching a pixel density of the image.

10

47. A tandem type image forming apparatus for  
forming an image, comprising:

15               an optical scanning apparatus for scanning a  
surface to be scanned by using a beam spot formed of an  
optical beam emitted from a semiconductor laser, the  
optical scanning apparatus comprising a liquid crystal  
element deflecting a light path of said optical beam on  
20        said surface to be scanned; and a light rotating part  
rotating a polarization plane of said optical beam;  
              a photoreceptor forming an electrostatic  
latent image scanned by said optical scanning apparatus;  
              a developing part developing said  
25        electrostatic latent image as a toner image with a

toner; and

a transferring part transferring said toner image in a recording medium,

wherein a plurality of said photoreceptors are 5 provided, said optical scanning apparatus scans said photoreceptors with a plurality of optical beams, and misalignment of a write start position between said photoreceptors is corrected.

10

48. A division scanning type image forming apparatus for forming an image, comprising:

15 an optical scanning apparatus for scanning a surface to be scanned by using a beam spot formed of an optical beam emitted from a semiconductor laser, the optical scanning apparatus comprising a liquid crystal element deflecting a light path of said optical beam on 20 said surface to be scanned and a light rotating part rotating a polarization plane of said optical beam;

a photoreceptor forming an electrostatic latent image scanned by said optical scanning apparatus;

25 a developing part developing said electrostatic latent image as a toner image with a

toner; and

a transferring part transferring said toner image in a recording medium,

wherein a plurality of said optical scanning apparatuses are aligned in line with respect to a main scanning direction for each photoreceptor and misalignment of said beam spot with respect to a main scanning direction around a connection area between scanning beams from said optical scanning apparatuses is corrected.

49. The division scanning type image forming apparatus as claimed in claim 48, wherein said misalignment of the beam spot around a connection area between scanning beams is corrected with respect to a subscanning direction.

ABSTRACT OF THE DISCLOSURE

An optical scanning apparatus scans a surface to be scanned in a main scanning direction by simultaneously using a plurality of optical spots formed 5 of a plurality of optical beams emitted from an illuminant, comprising: a light path deflecting part deflecting a light path of at least one of the optical beams, wherein the light path deflecting part is provided in light paths of the optical beams wherein the 10 light path deflecting part may use a liquid crystal deflecting element formed of a liquid crystal element being controllable by an electronic signal to deflect the light path of the one of the optical beams.

FIG. 1

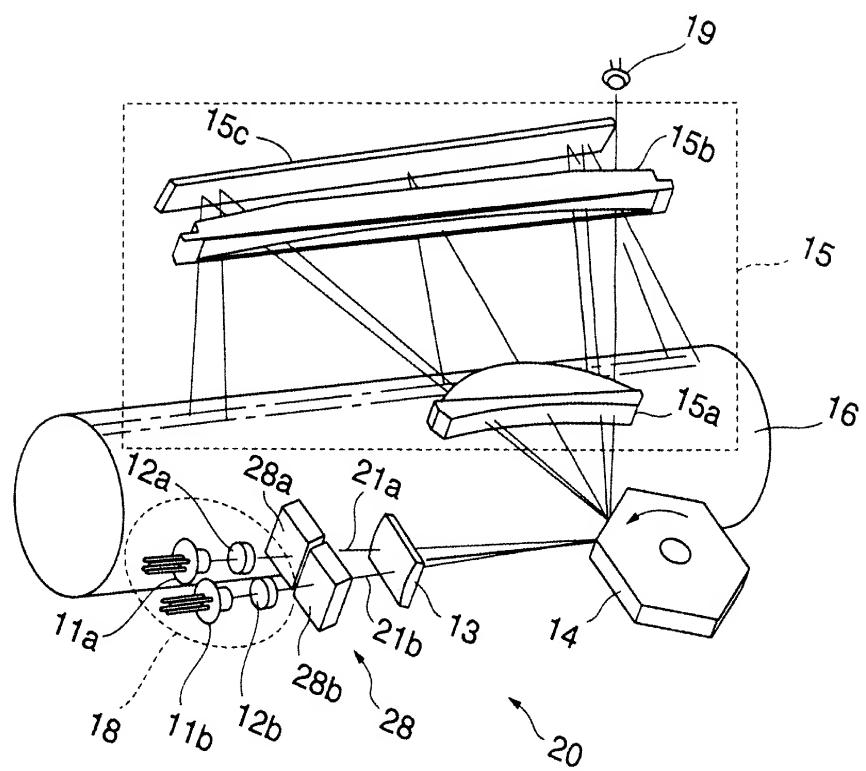


FIG. 2

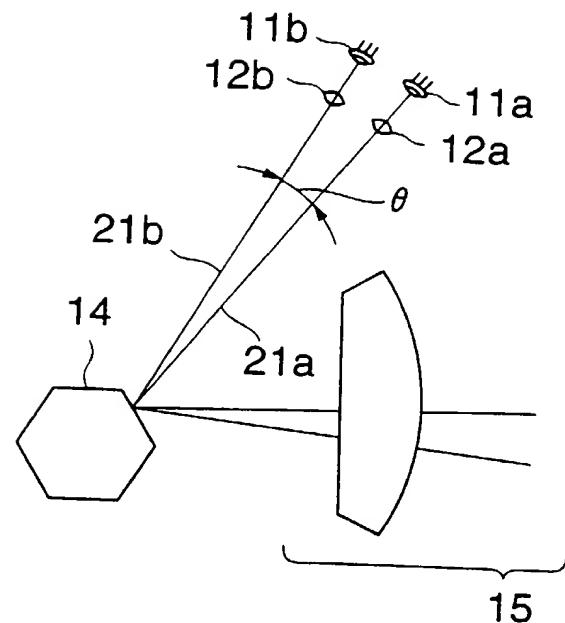


FIG. 3

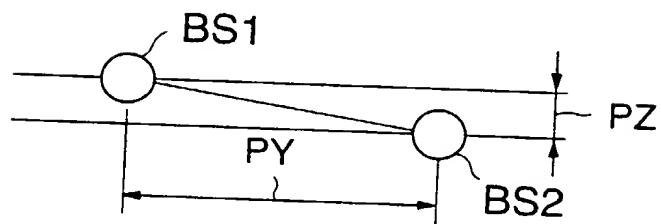


FIG. 4

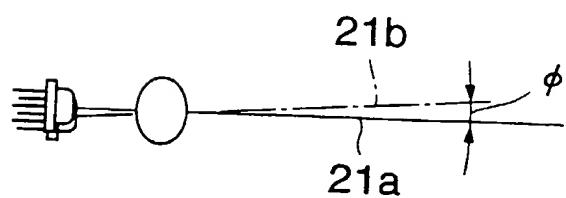


FIG. 5A

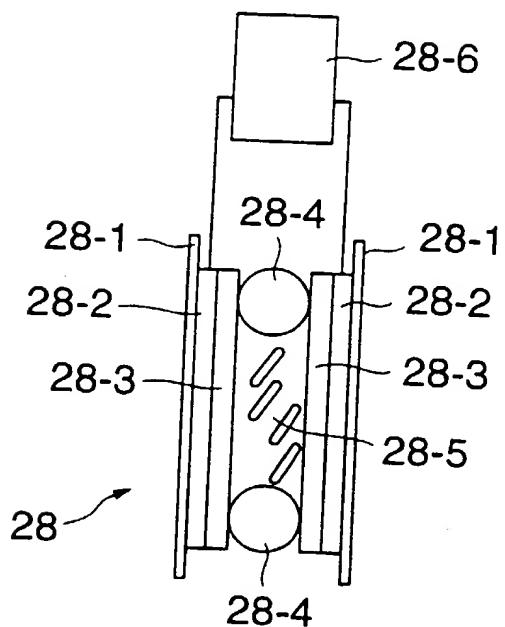


FIG. 5B

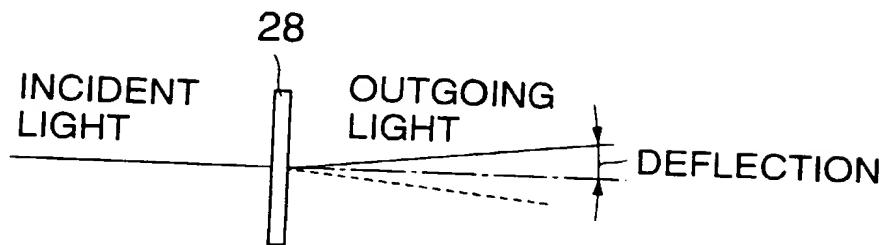


FIG. 6

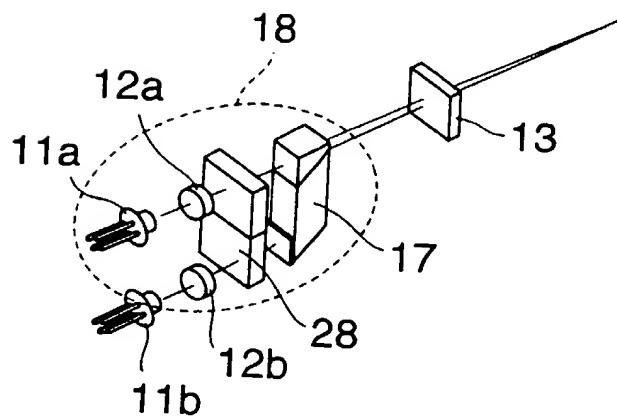


FIG. 7A                    FIG. 7B                    FIG. 7C

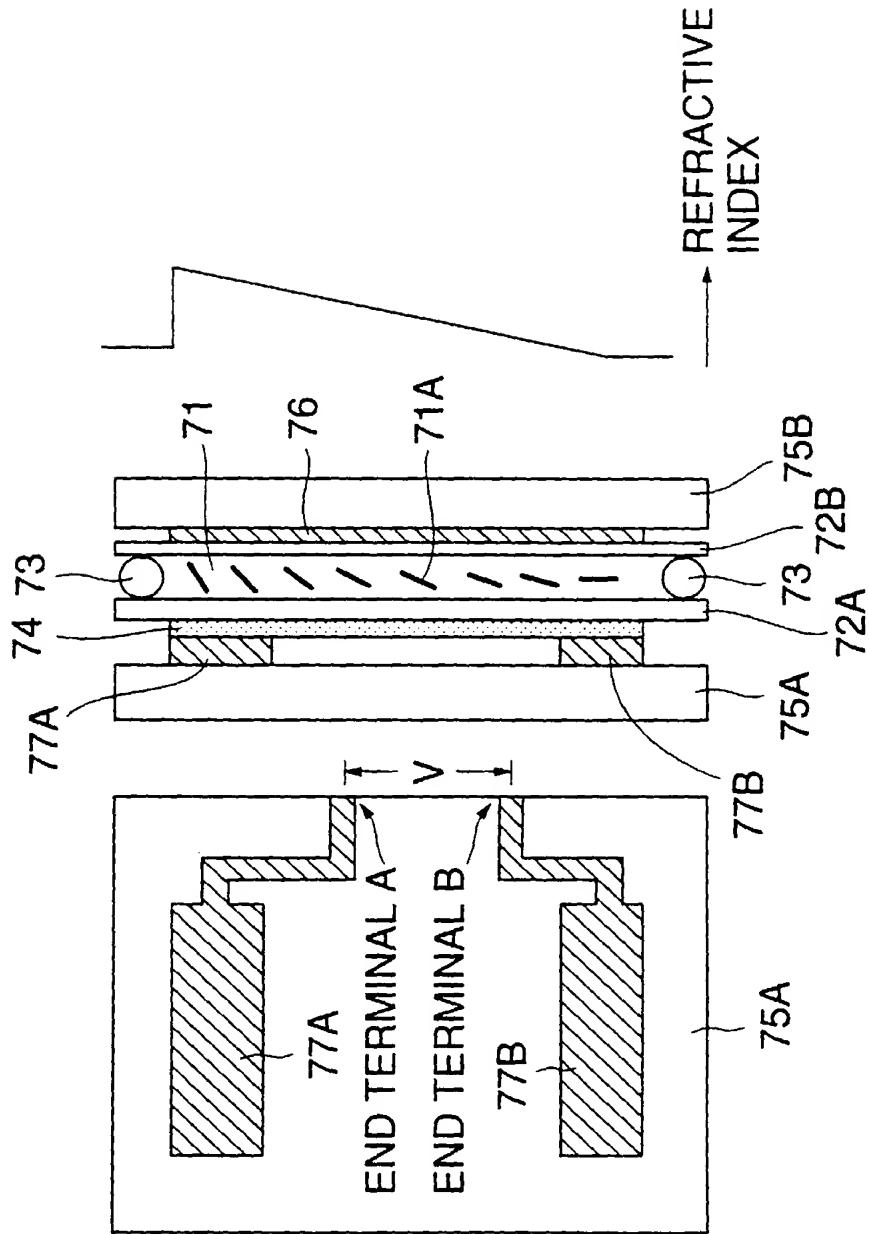


FIG. 8A

FIG. 8B

FIG. 8C

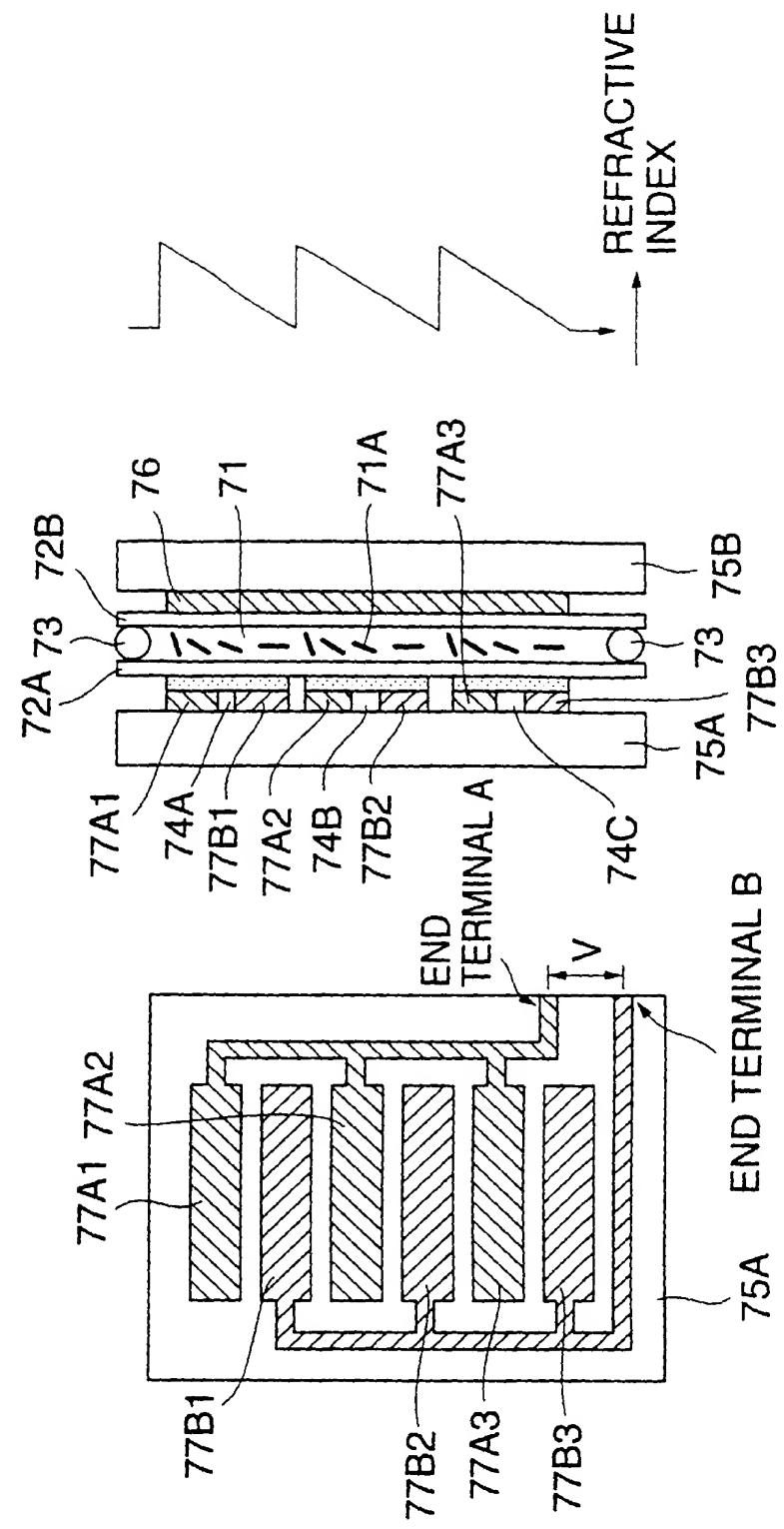


FIG. 9A

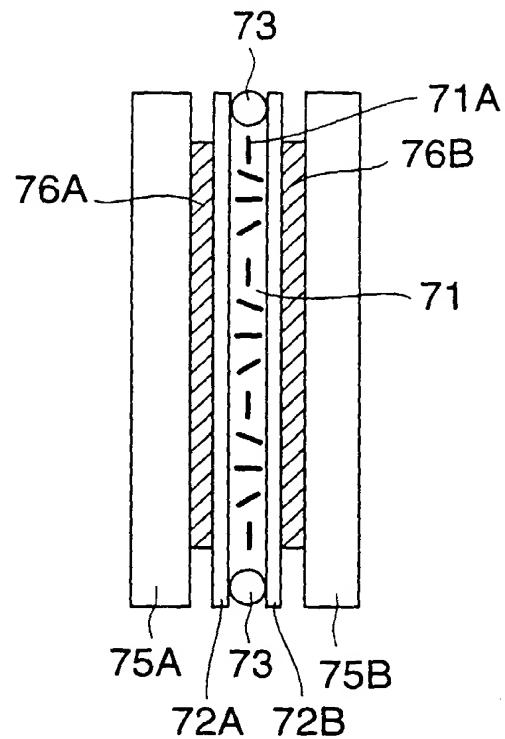


FIG. 9B

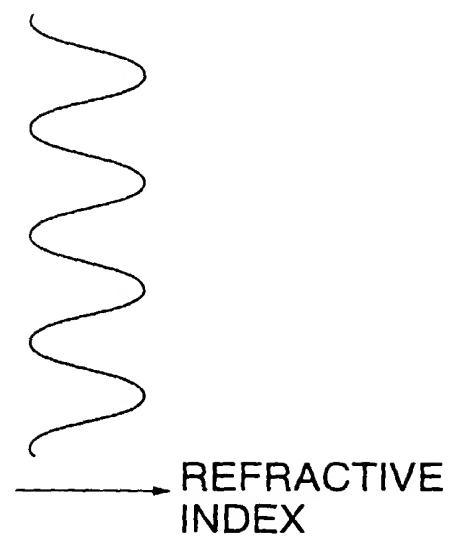
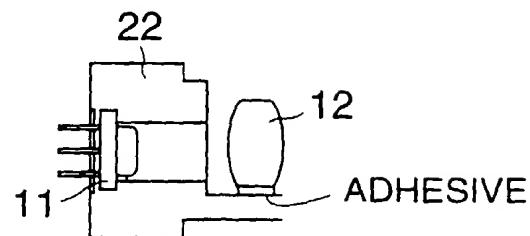


FIG. 10



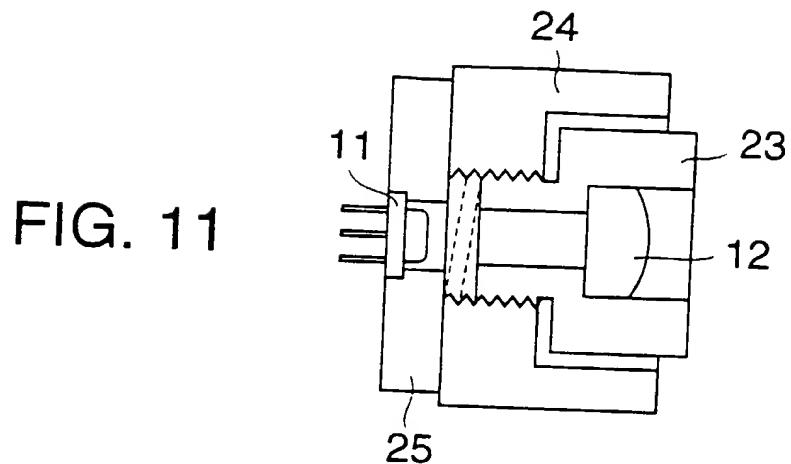


FIG. 11

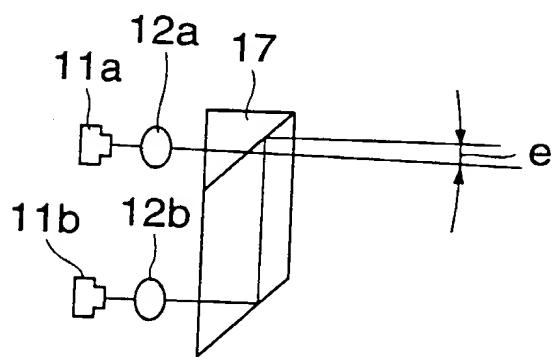


FIG. 12

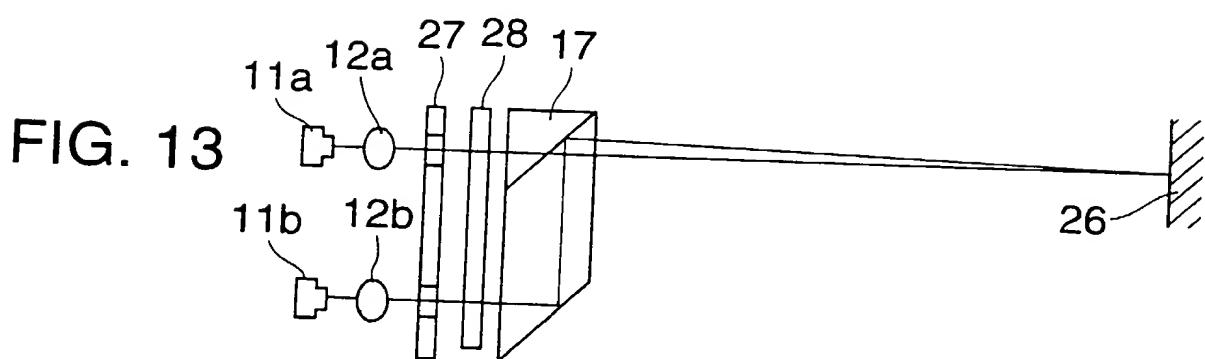


FIG. 13

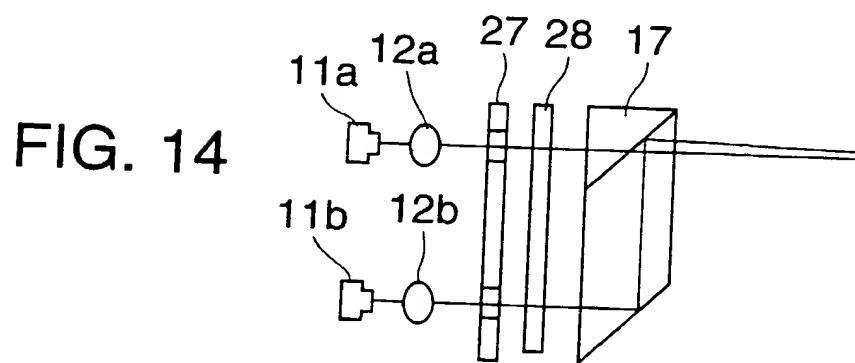


FIG. 14

FIG. 15

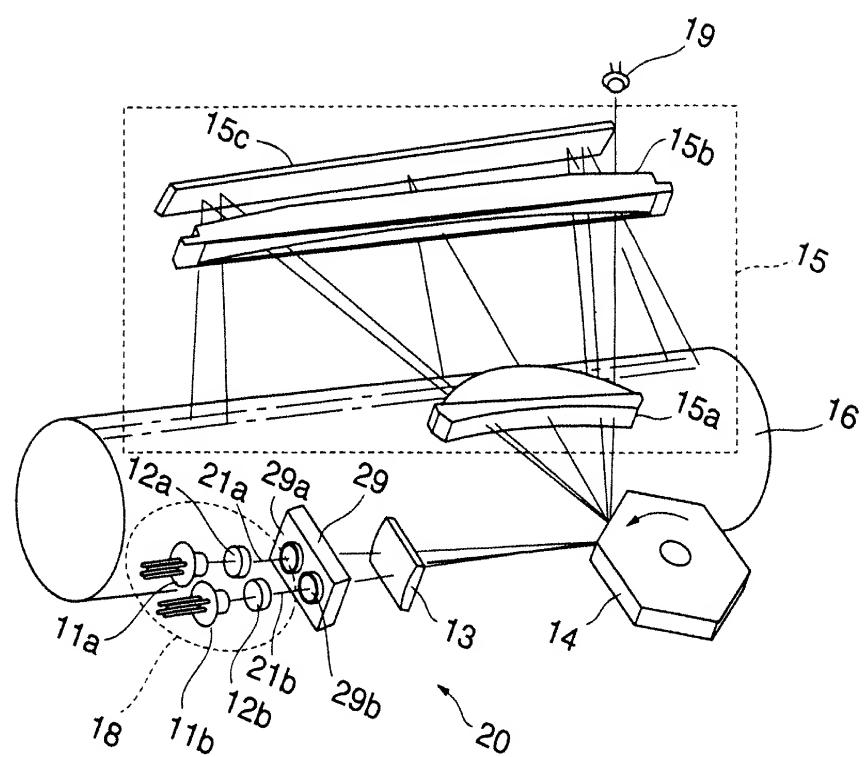


FIG. 16

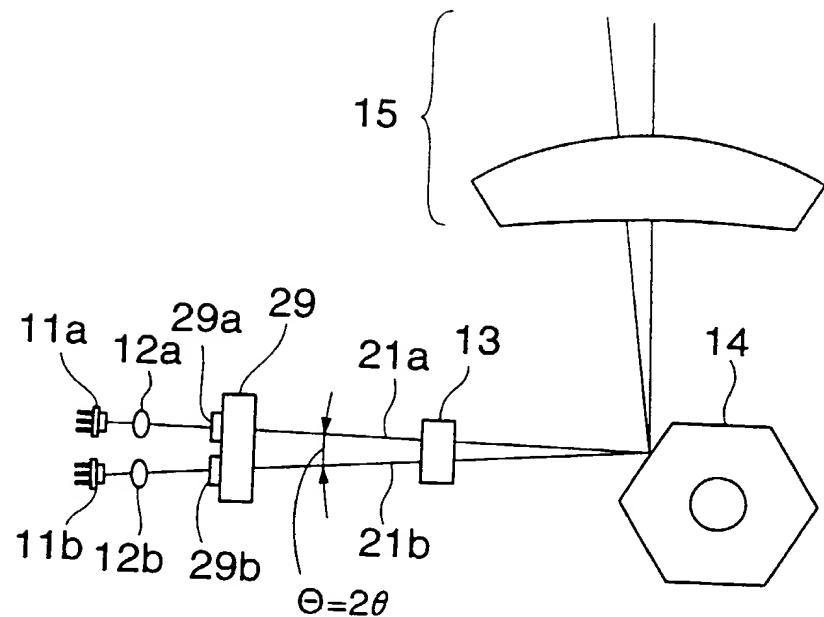


FIG. 17

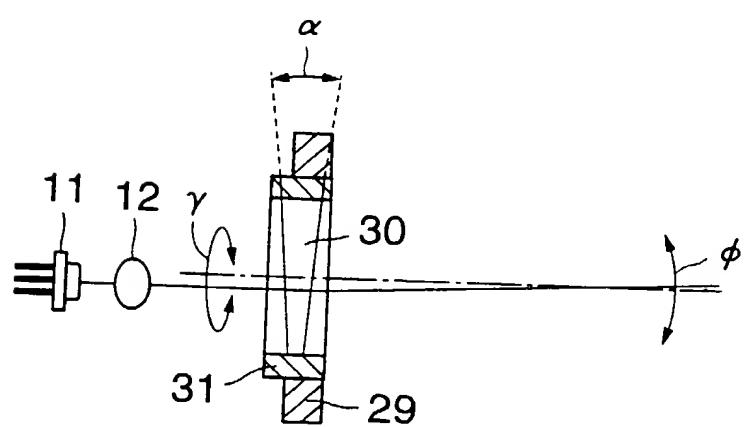


FIG. 18A

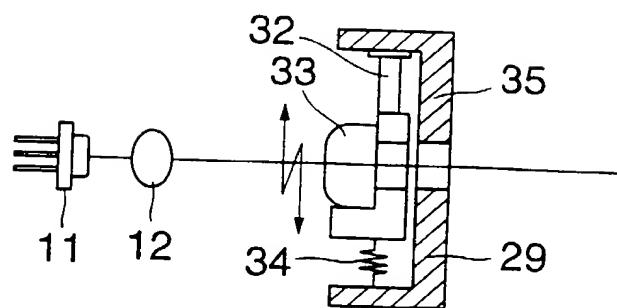


FIG. 18B

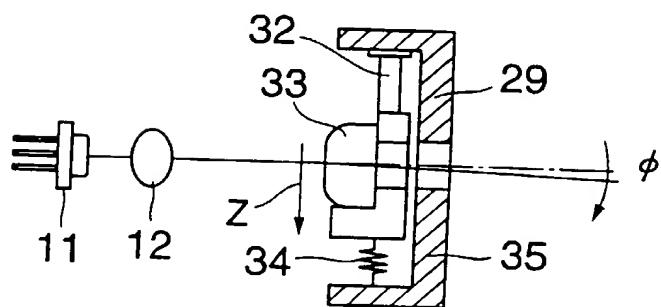


FIG. 18C

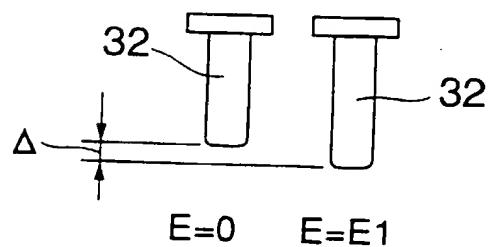


FIG. 19A

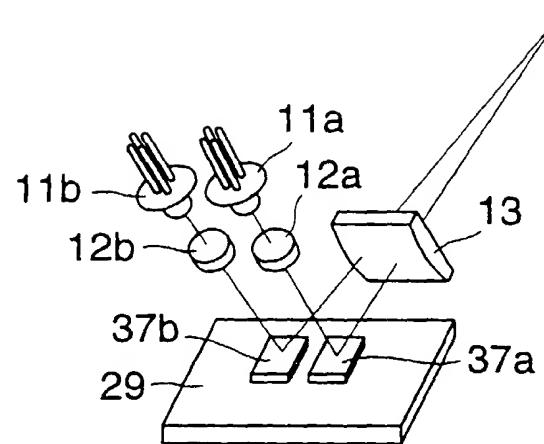


FIG. 19B

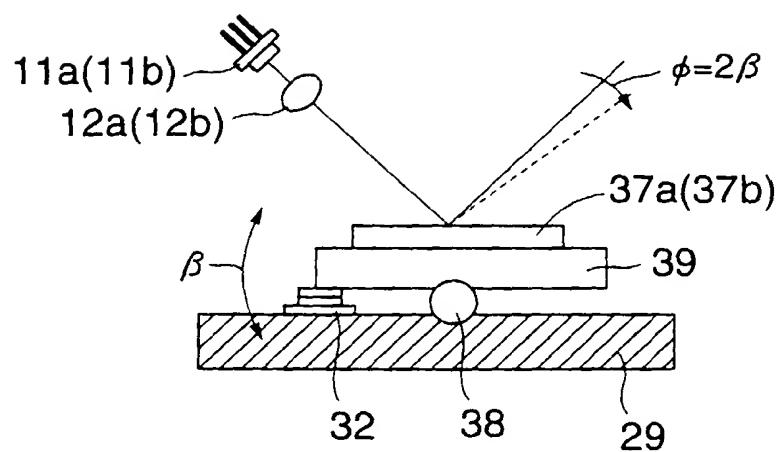


FIG. 20A

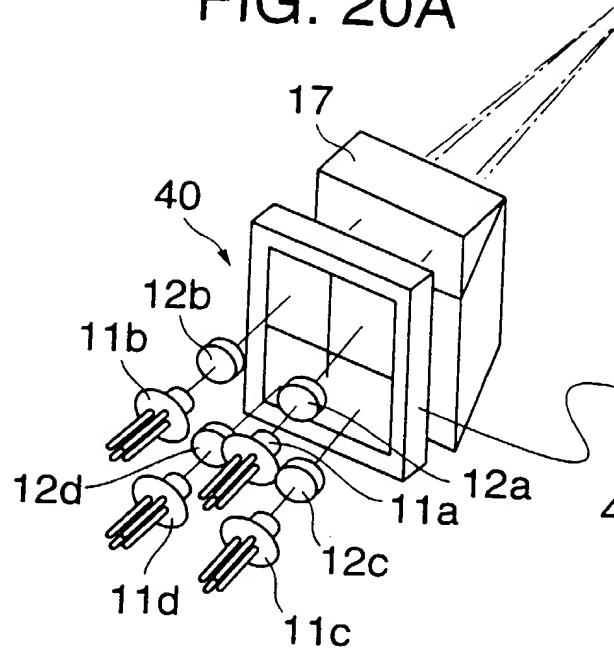


FIG. 20B

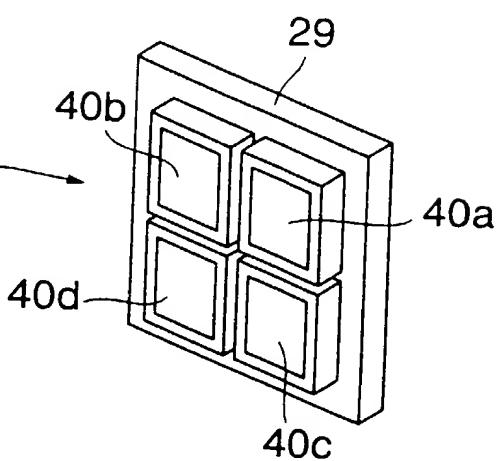


FIG. 21

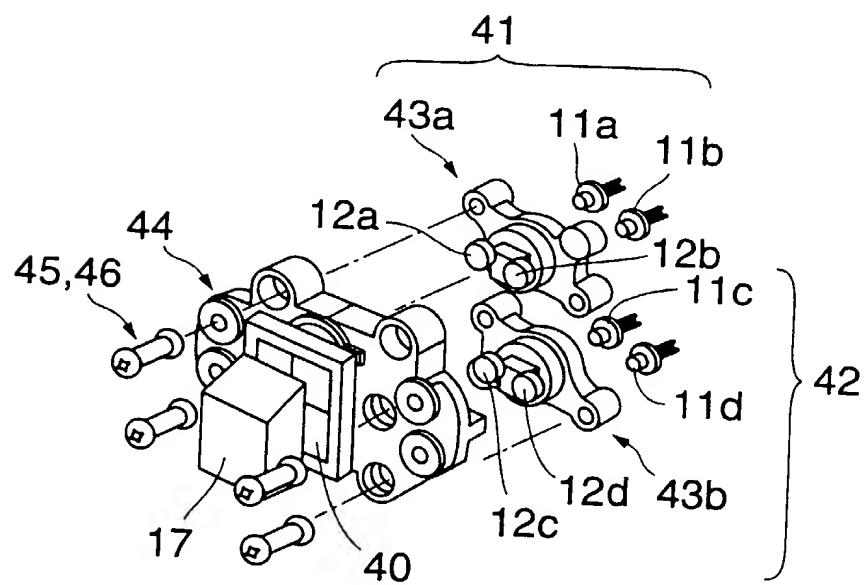


FIG. 22A

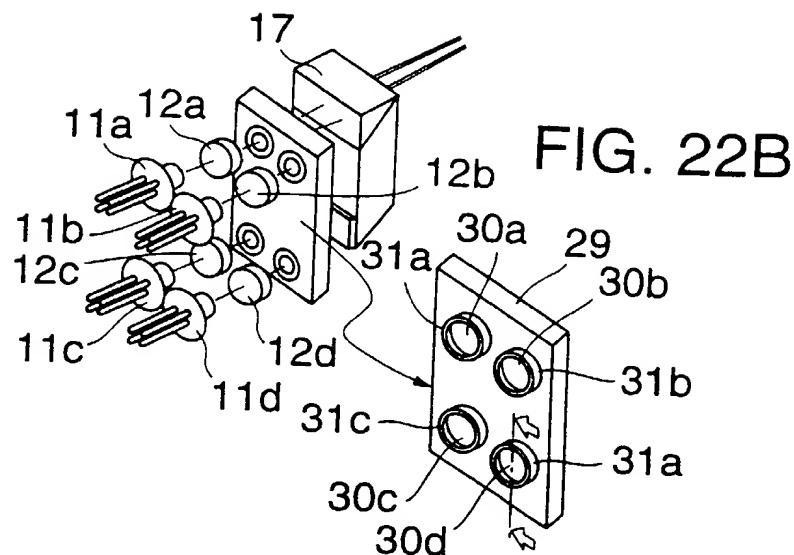


FIG. 22B

FIG. 23A

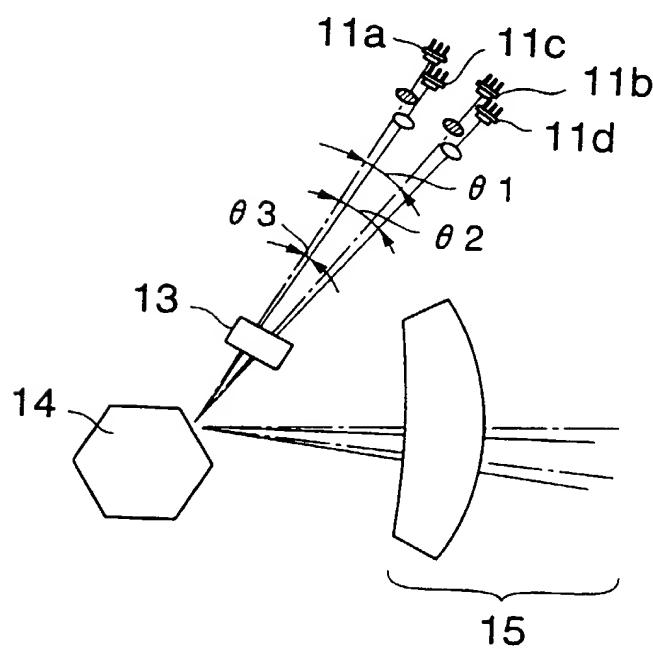


FIG. 23B

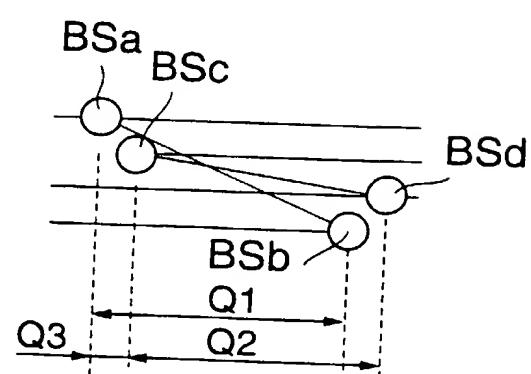


FIG. 24

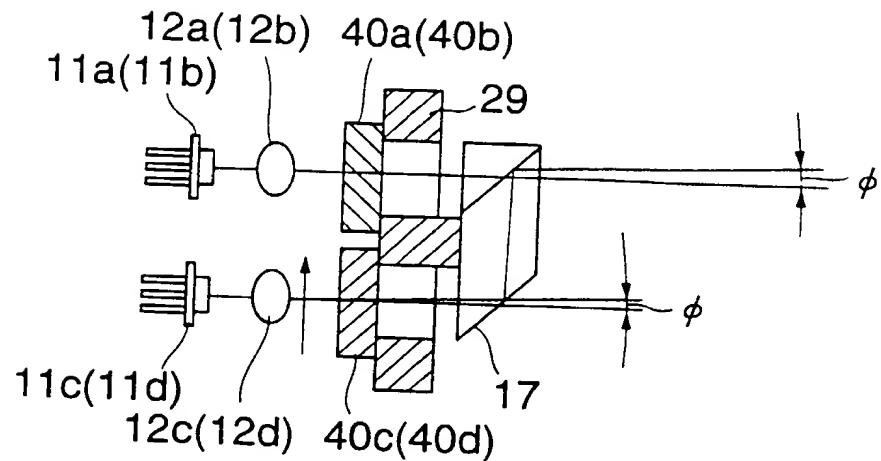


FIG. 25

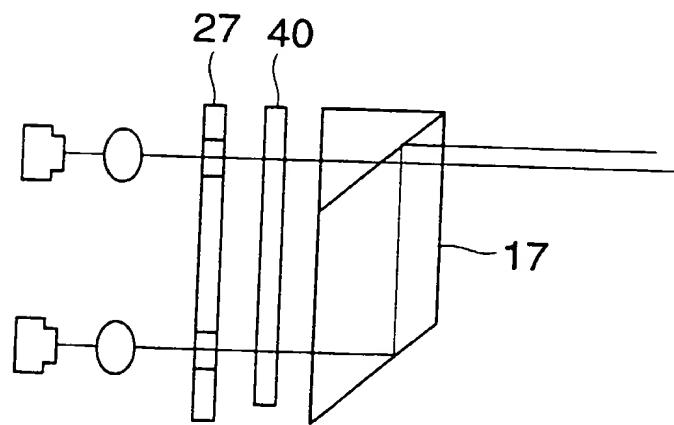


FIG. 26A

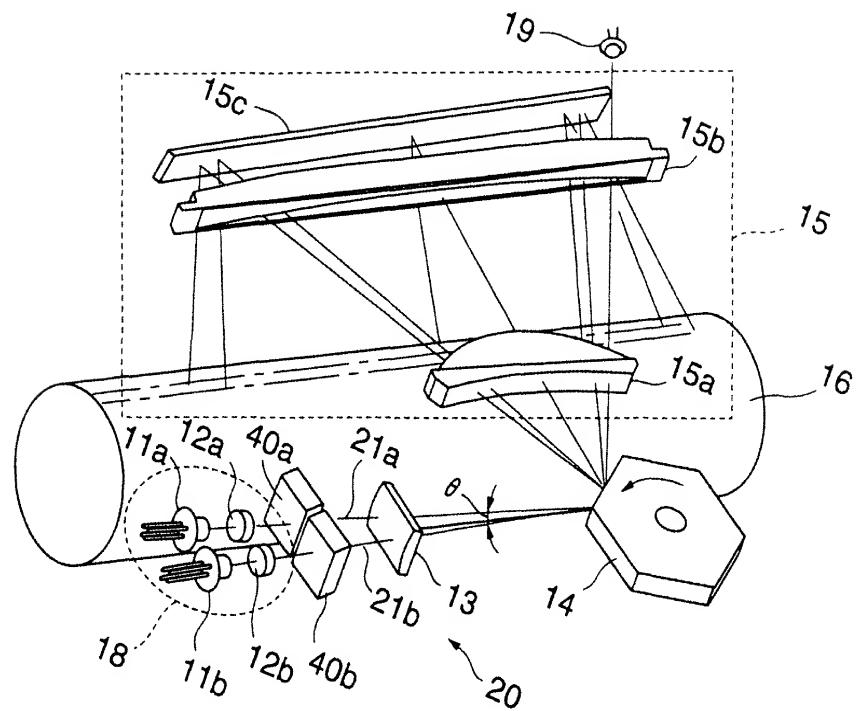


FIG. 26B

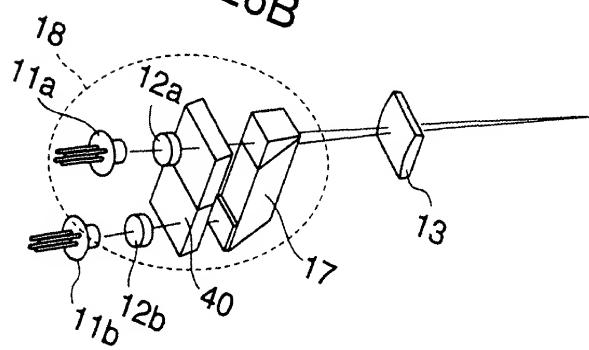


FIG. 27

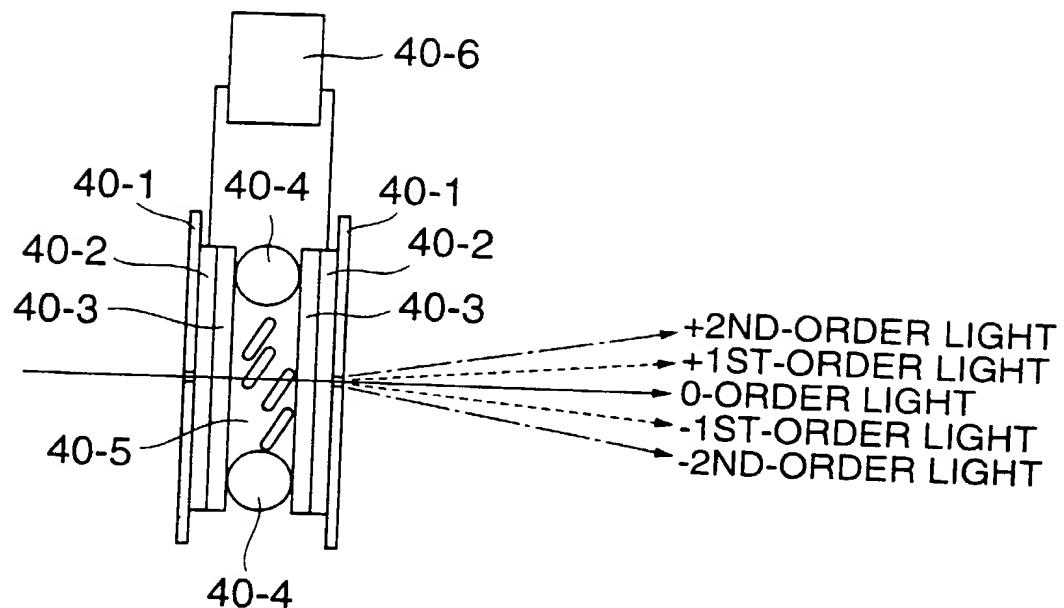


FIG. 28

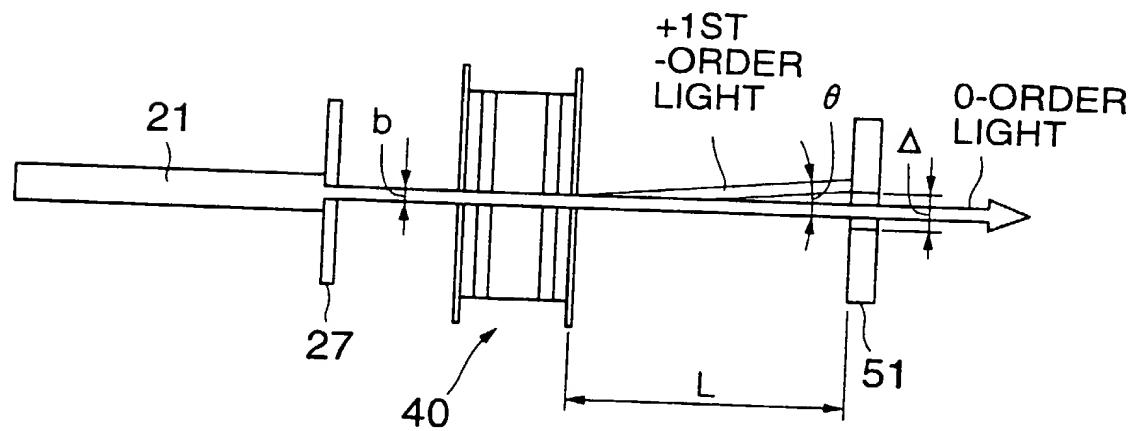


FIG. 29A

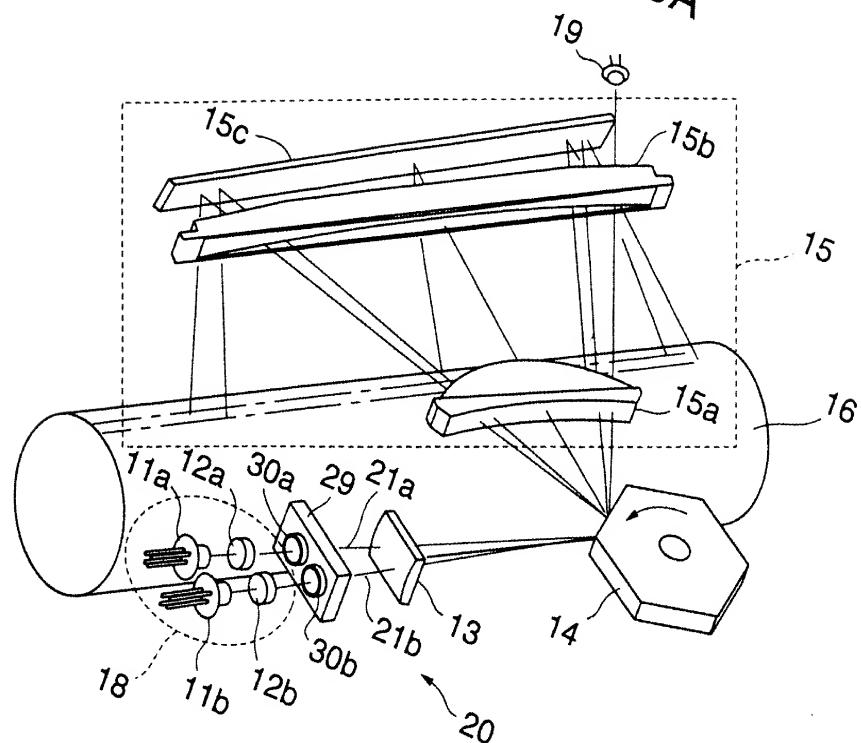


FIG. 29B

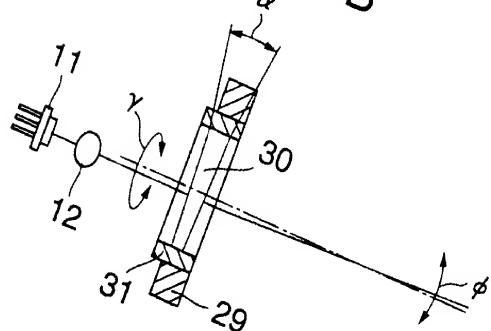


FIG. 30

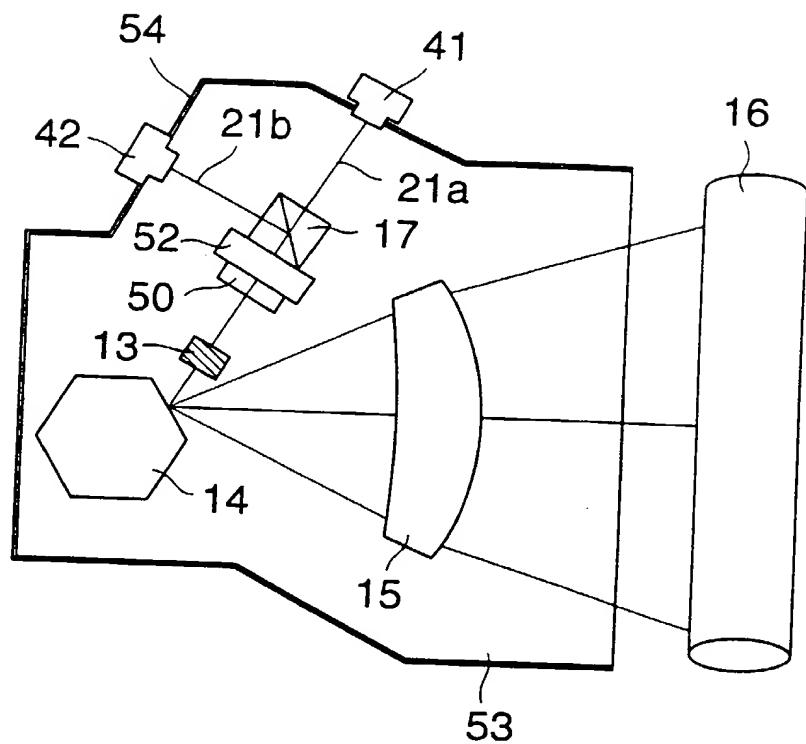


FIG. 31A

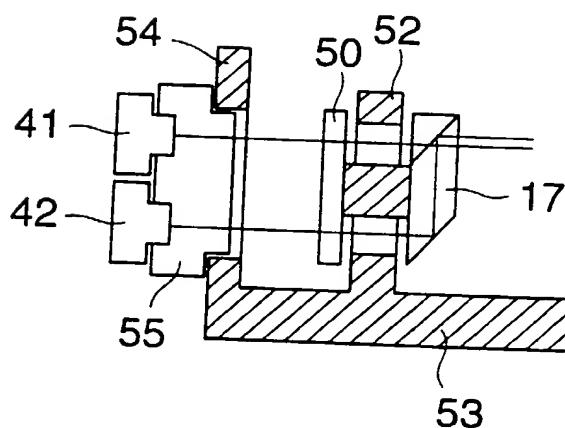


FIG. 31B

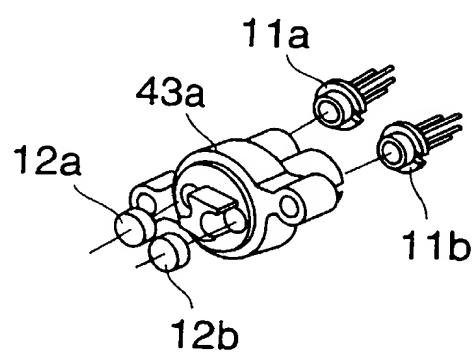


FIG. 32

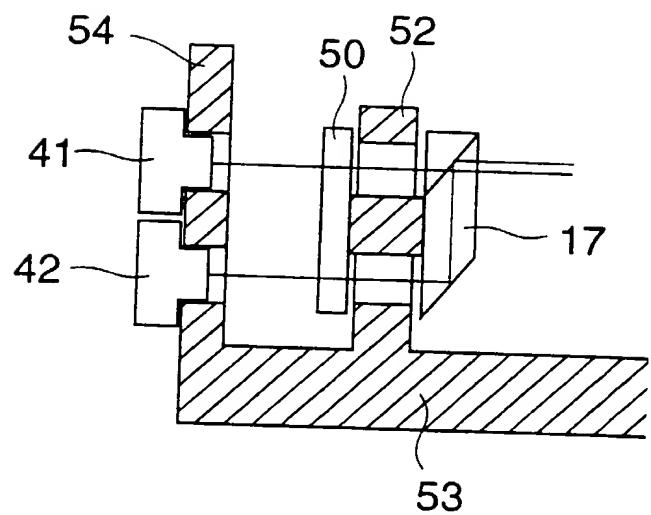


FIG. 33A

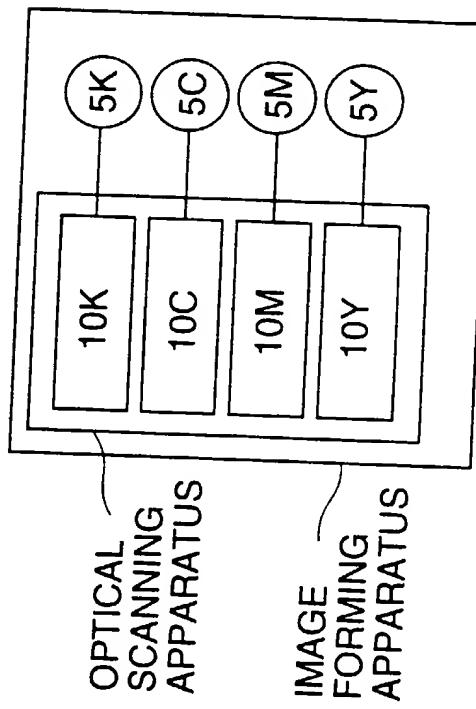


FIG. 33C

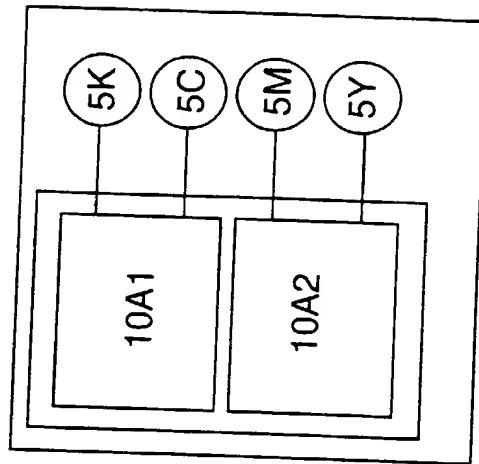


FIG. 33B

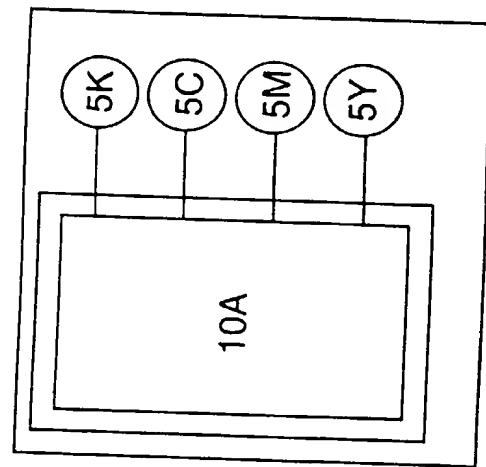


FIG. 33D

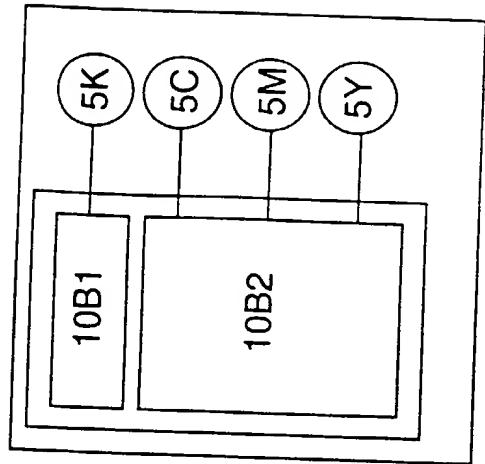


FIG. 34

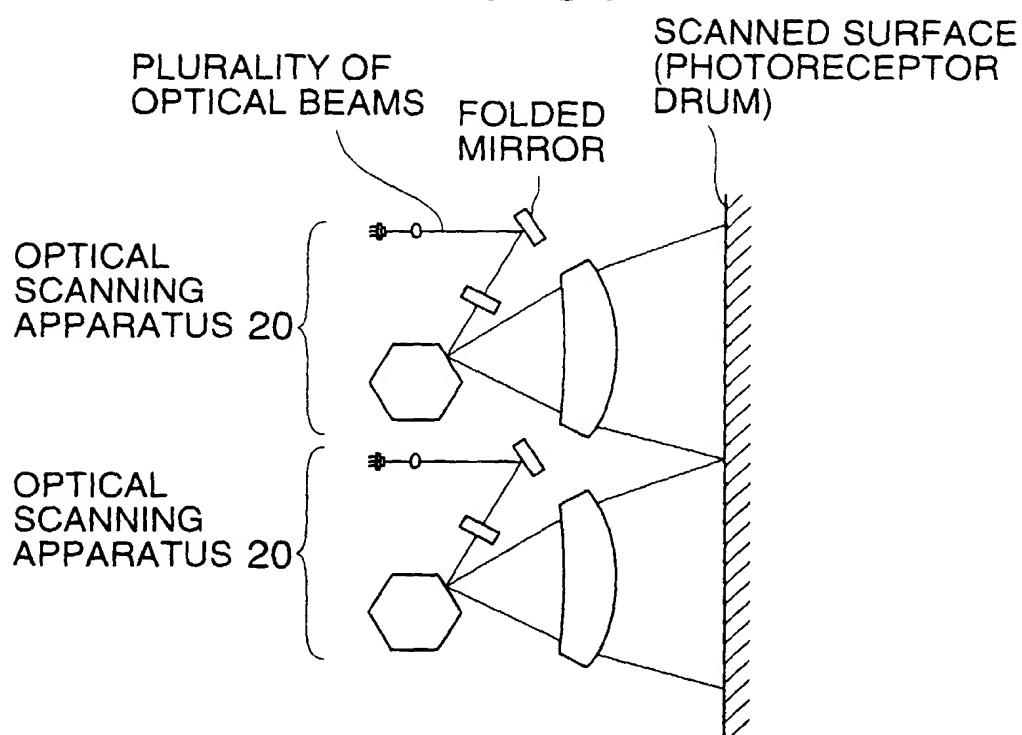


FIG. 35

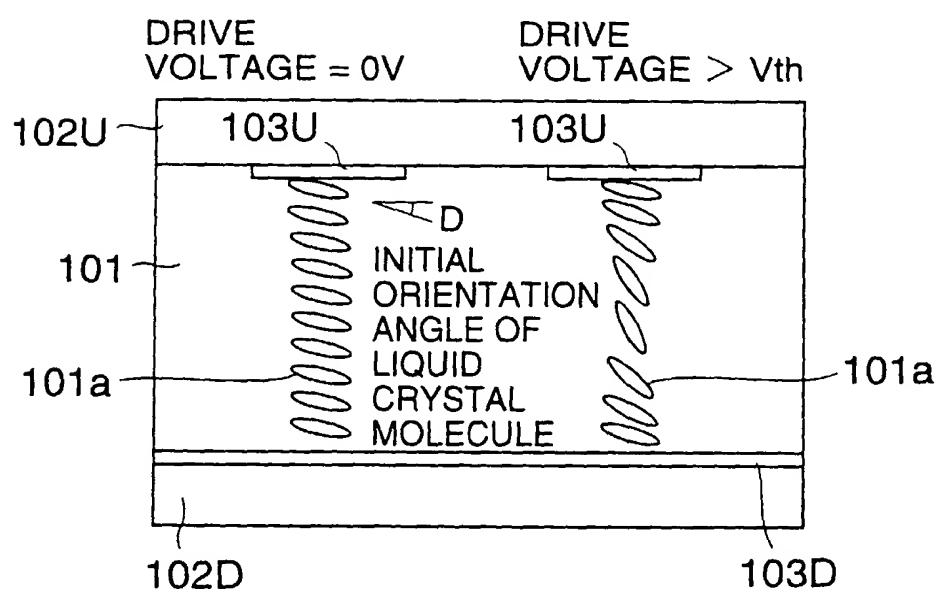


FIG. 36

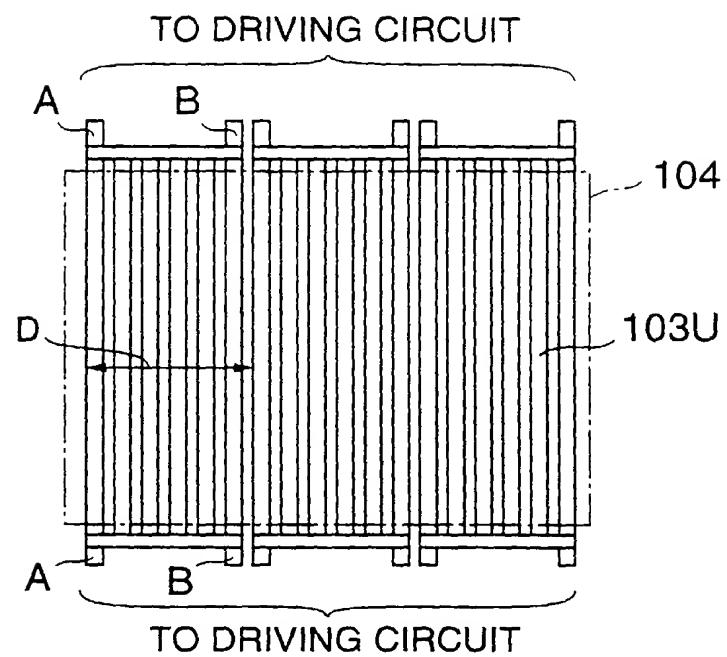


FIG. 37

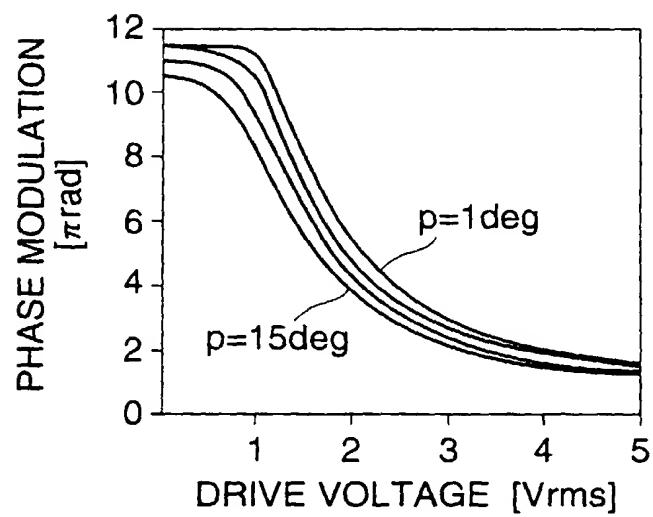


FIG. 38

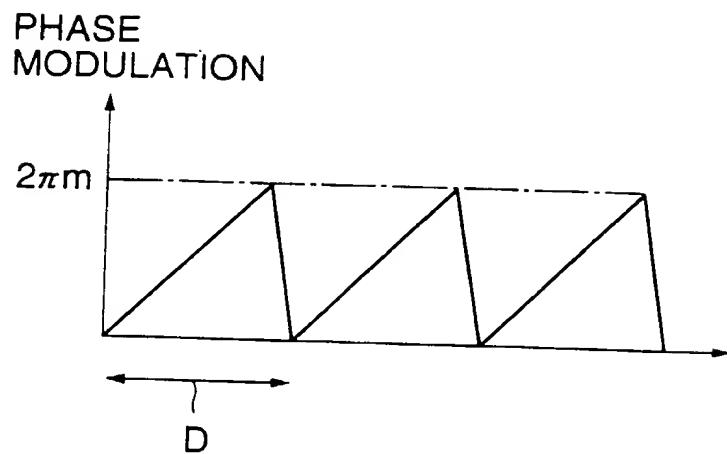


FIG. 39

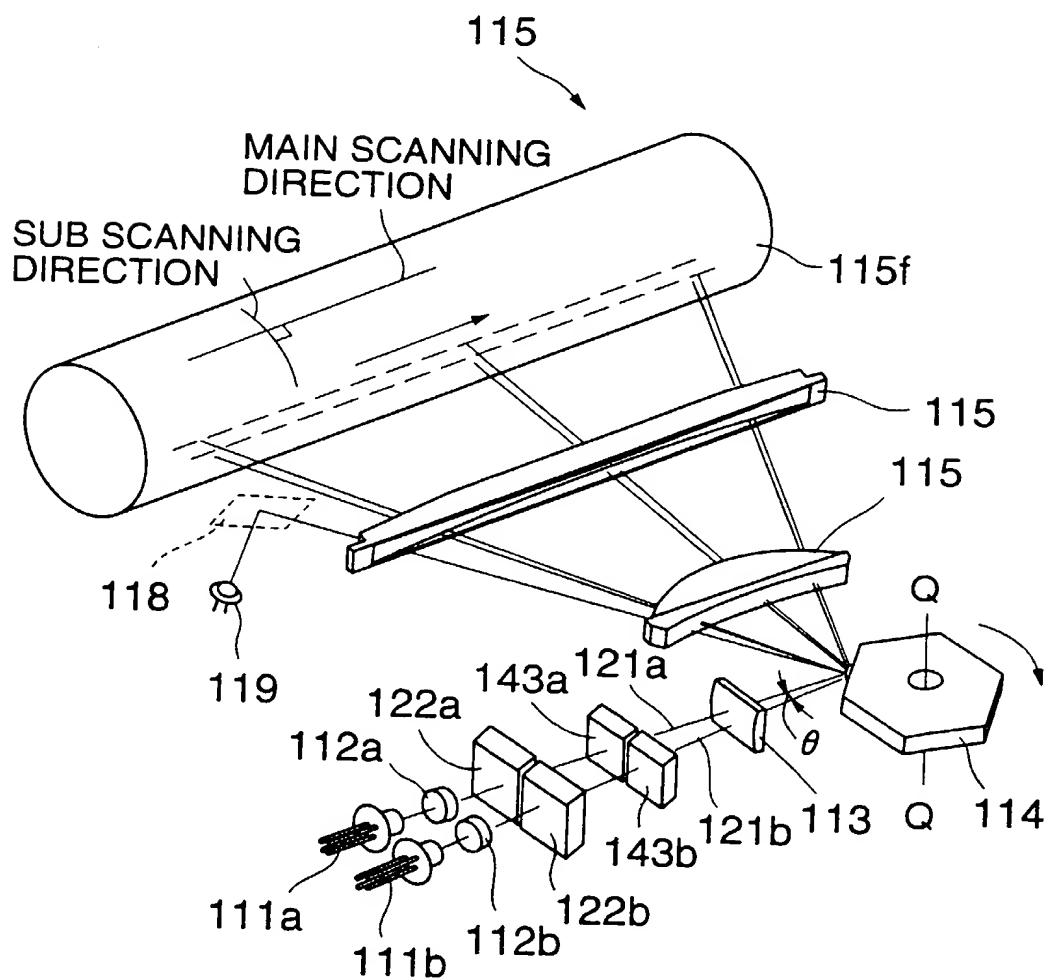


FIG. 40

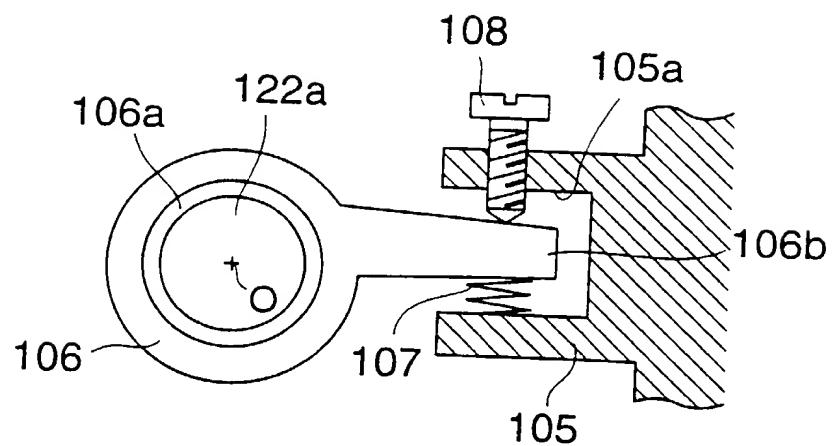


FIG. 41

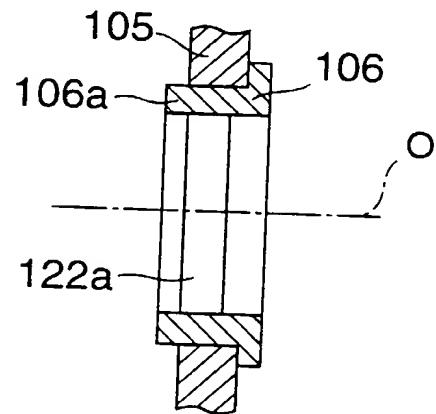


FIG. 42

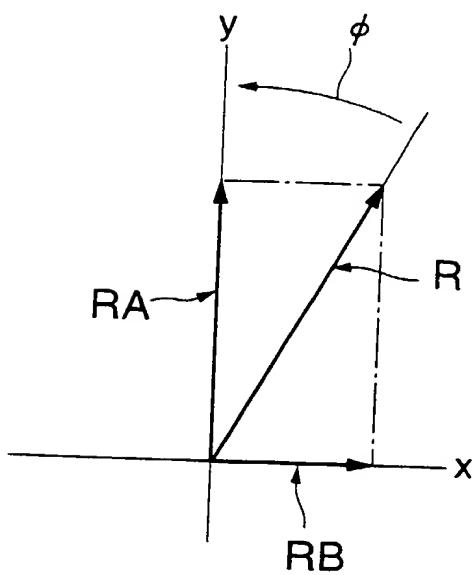


FIG. 43

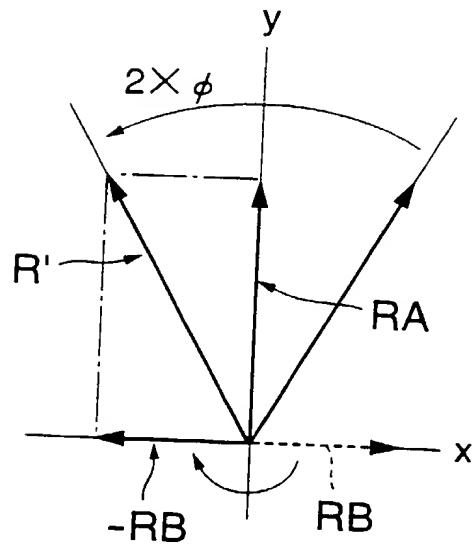


FIG. 44

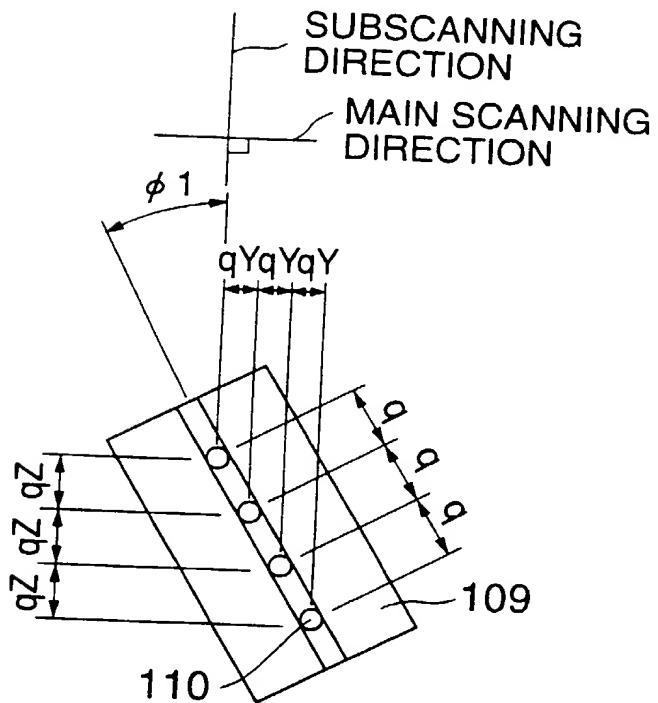


FIG. 45

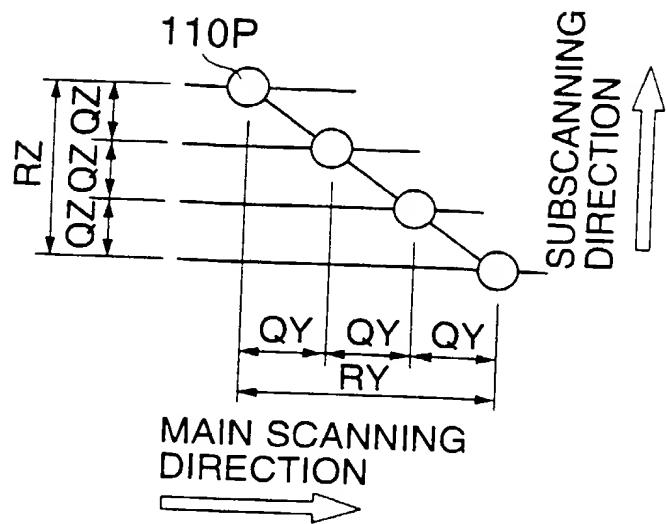


FIG. 46

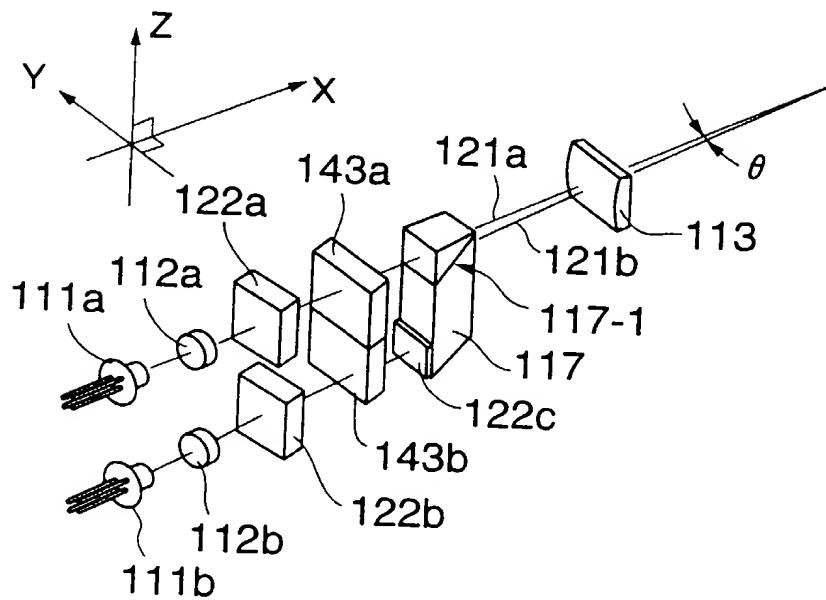


FIG. 47

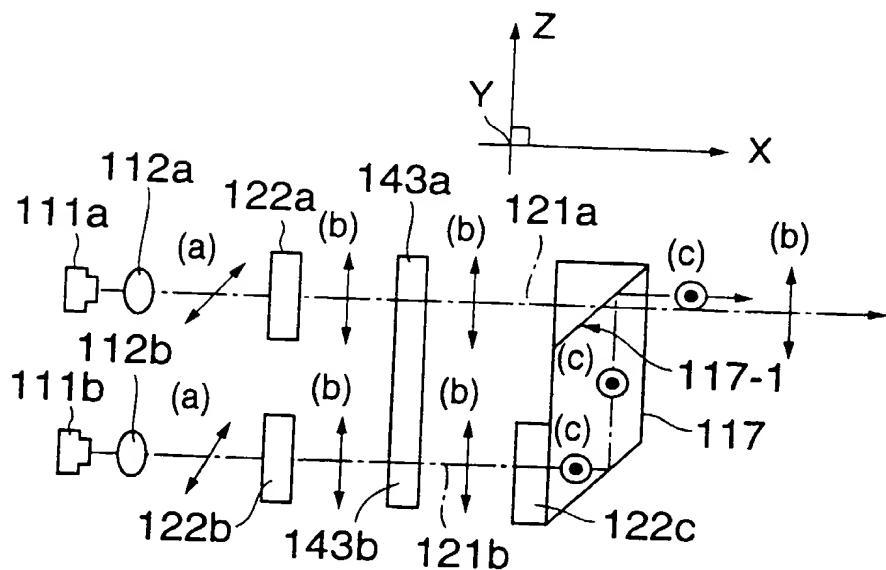


FIG. 48

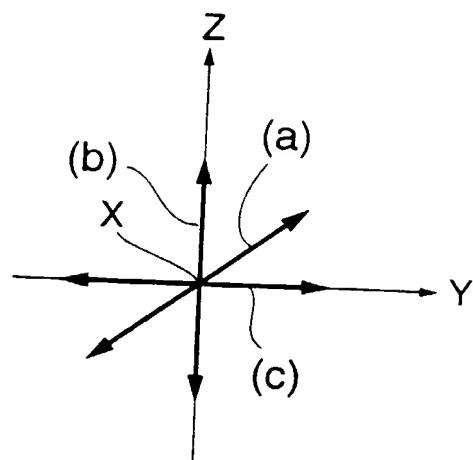


FIG. 49

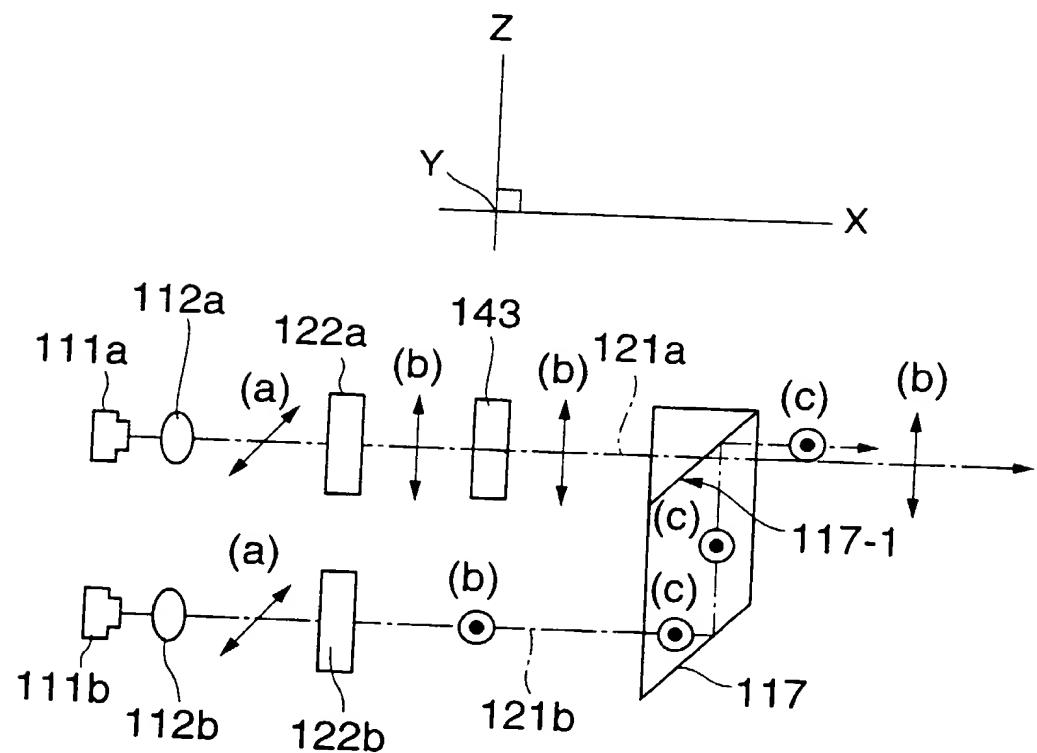


FIG. 50

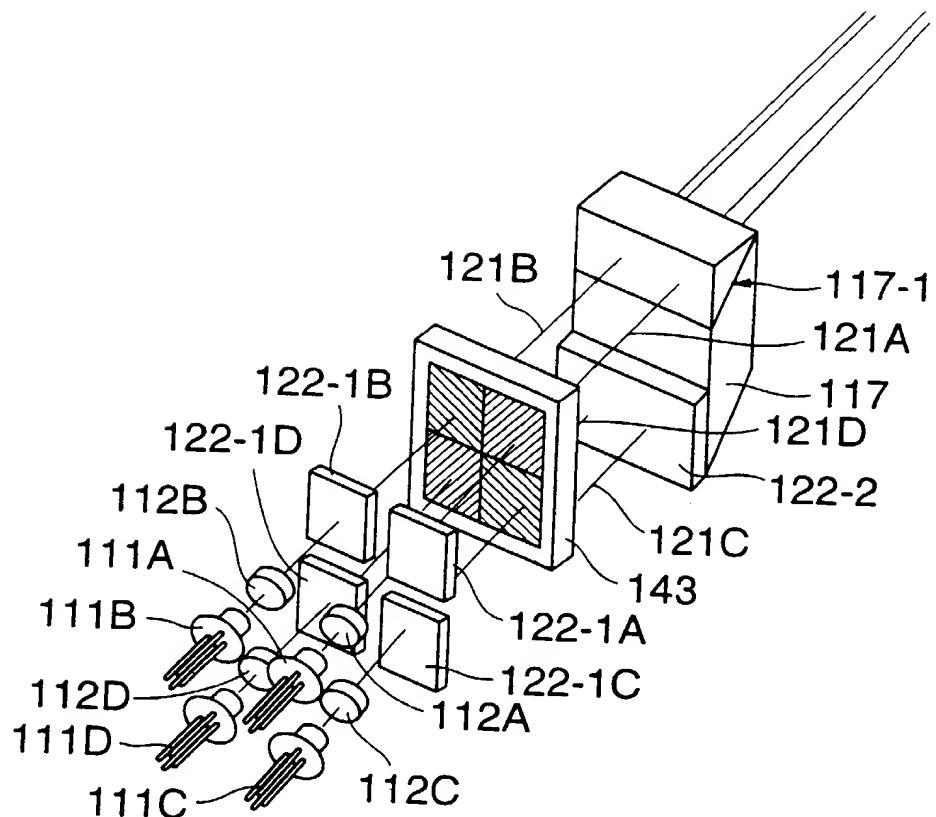


FIG. 51

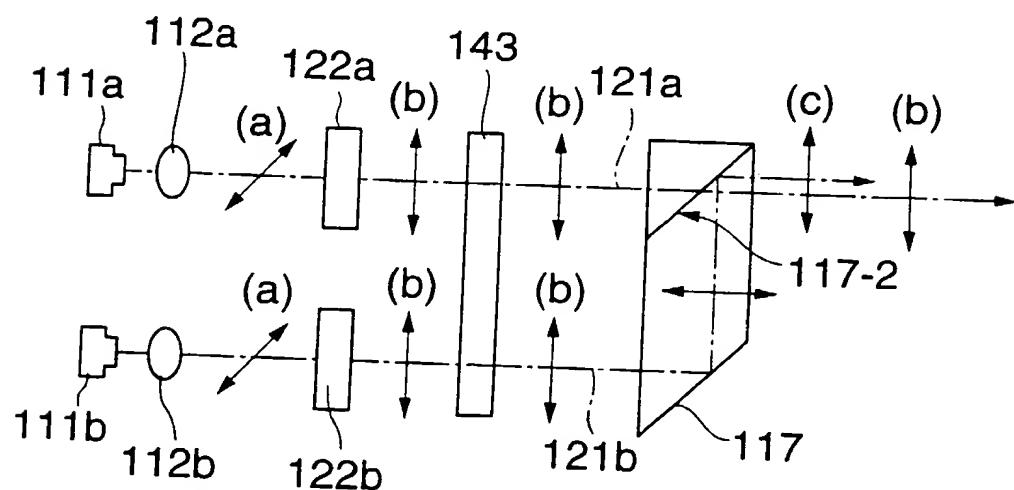


FIG. 52

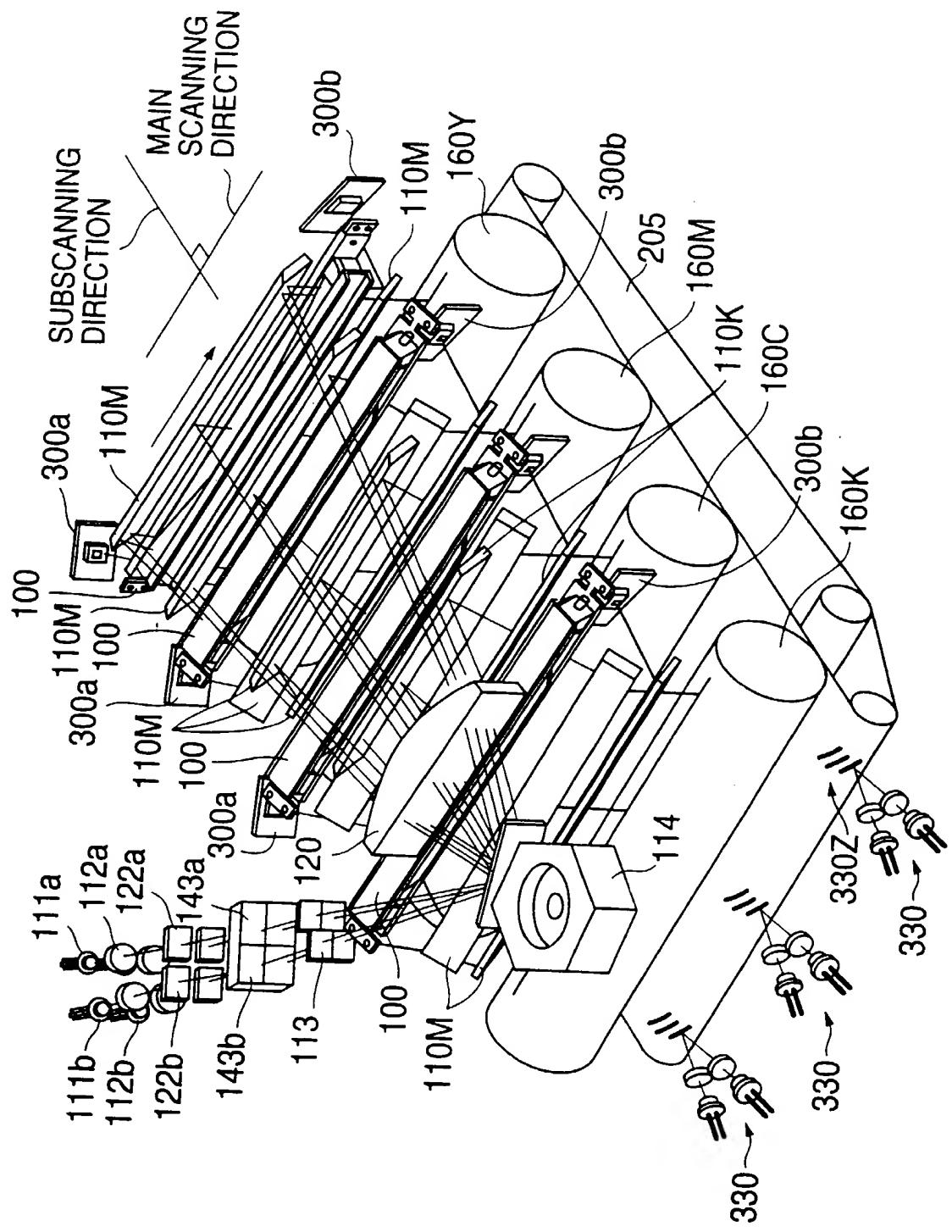


FIG. 53

